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# EXPERIMENTAL DISSEMINATION OF THE TABANID EGG PARASITE PHANURUS EMERSONI GIRAULT AND BIOLOGICAL NOTES ON THE SPECIES

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## INTRODUCTION

For a number of years prior to 1913 stockmen whose ranches lie along the south escarpment of the Edwards Plateau, north of Uvalde, Tex., experienced considerable trouble from the attacks of horseflies on their cattle and horses. During the summer of 1913 a rather severe outbreak of anthrax occurred in this region, and circumstantial evidence, as well as some investigational work done by the State board of health, indicated that these horseflies played a part in the transmission of the disease. This combination of conditions made a study of the horseflies and their control of distinct economic importance.<sup>1</sup>

The study was begun in the summer of 1914, and during the first days of September of that season an egg parasite was found, which was later described as a new species, *Phanurus emersoni*, by Girault.<sup>2</sup> The horsefly eggs were so abundant at Laguna Crossing on the Nueces River, 20 miles north of Uvalde, that a boy was able to collect 9 pints of egg masses, or approximately 2,000,000 eggs, in one day. In sample masses of these eggs, 97 per cent of the masses were parasitized, and from 6 to 83 parasites emerged from each mass. From these data it was inferred that the most feasible means of

<sup>1</sup>The work was initiated and carried on under the direction of F. C. Bishopp, and the writer is indebted to W. E. Dove for assistance in summarizing the notes and for suggestions as to preparation of manuscript and illustrations.

<sup>2</sup>GIRAULT, A. A. A NEW PHANURUS FROM THE UNITED STATES, WITH NOTES ON ALLIED SPECIES. Can. Ent. 48: 149-150, 1916.



control of the fly would be to collect the horsefly eggs and place them along the streams in vessels which would allow the parasites to escape but which would retain the fly larvae to be destroyed. This circular reports some biological studies of the egg parasite and experimental work in horsefly control by egg collection and parasite dissemination.

### DISTRIBUTION AND HOSTS OF THE PARASITE

The parasite has been reared from the eggs of *Tabanus hyalinipennis* Hine from the counties of Sutton, Edwards, Kinney, Menard, Kimble, Kerr, Bandera, Real, Uvalde, Zavalla, Medina, Bexar, Comal, Kendall, Blanco, Gillespie, Mason, Llano, San Saba, and McCulloch in southwestern Texas. The parasite was found in most, if not all, of these counties before general distributions were made. Webb and Wells<sup>3</sup> reported it as parasitizing practically every egg mass of *T. punctifer* O. S. at Topaz, Calif. Cameron<sup>4</sup> states that eggs of *Chrysops moerens* Walker and *C. mitis* O. S. were fairly commonly parasitized by *Trichogramma minutum* (Riley) and *Phanurus emersoni* in western Canada.

### PHYSICAL AND CLIMATOLOGICAL CONDITIONS OF THE PARASITE BREEDING GROUNDS IN SOUTHWESTERN TEXAS

The contour of the south escarpment of Edwards Plateau may be described as rather rugged. The elevation of the plateau is about 2,300 feet above sea level, and the elevation of the stream beds where they leave the valleys and enter the Gulf plains is about 1,000 feet. Some of the peaks and divides near the mouths of the valleys are about 2,000 feet above sea level, and there are many high, rocky cliffs. The parasite has been found to breed at elevations of from 800 to approximately 2,000 feet. The escarpment is cut by narrow valleys from 20 to 60 miles long, with many shorter tributaries leading out. Nearly all of these valleys have permanent springs in the heads, and most of the main valleys have permanent streams, some of considerable size. They all have heavy growths of timber along the streams, and in places there are small swampy areas with dense vegetative growths. The heads of the streams are narrow and are more or less shaded, but in the lower parts of the valleys they spread out over gravel beds 100 or more yards wide and are exposed to the sun, since flood waters have stunted the timber growth for some distance from the main channels.

The climate of this area is semiarid, with hot summers, usually dry, and mild winters. During the summer the maximum temperatures are generally near 100° F., the nights are cool, and the minimum temperatures are usually about 70°. The minimum temperatures during the winters are rarely below 20°. The annual rainfall at Uvalde has varied from 12 to 40 inches, with an average of approximately 21 inches. The annual rainfall increases toward the east and diminishes westward. Usually more rain falls during the months of May and September than during other months.

<sup>3</sup> WEBB, J. L., and WELLS, R. W. HORSEFLIES: BIOLOGIES AND RELATION TO WESTERN AGRICULTURE. U. S. Dept. Agr. Bul. 1218, 35 pp., illus., 1924.

<sup>4</sup> CAMERON, A. E. BIONOMICS OF THE TABANIDAE (DIPTERA) OF THE CANADIAN PRAIRIE. Bul. Ent. Research 17 (pt. 1): 1-42, illus., 1926.



The eggs of *Tabanus hyalinipennis* are deposited mostly on stones from 3 to 15 inches in diameter, projecting above the water from 1 to 12 inches in rapids where the streams spread over the gravel beds in sunny, open places. (Fig. 1.) Some eggs are deposited on plants growing in the rapids and along the water's edge. The eggs have never been found in the swamps and rarely ever in places shaded for most of the day. The parasite prefers the open, sunny stretches of the streams, and the eggs on stones are usually most heavily parasitized, but at times the eggs on the plants are quite as heavily parasitized. The adults are most active during bright hot weather and have never been observed active in misty or rainy weather. The heaviest infestations of the horseflies have occurred following seasons when there were heavy and continued summer rains; this may be accounted for by the facts that during such

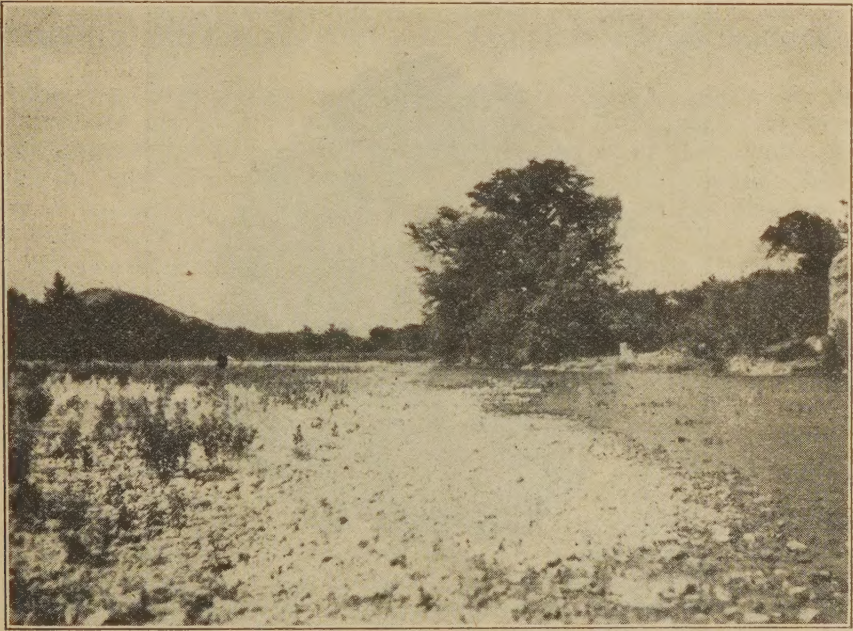


FIG. 1.—Gravel bar along the Frio River, where *Phanurus emersoni* parasitizes a large percentage of *Tabanus* eggs

seasons the fly-breeding grounds in the streams are greatly increased and the activity and breeding of the parasite are retarded:

#### LIFE CYCLE AND SEASONAL ACTIVITIES OF THE PARASITE

The adults copulate almost as soon as they emerge and are dry. Oviposition begins in from 4 to 24 hours after emergence. In the act of ovipositing, the female inserts the ovipositor into the membrane of the fly egg. She appears to be able to insert the ovipositor between the eggs of the top layers into the eggs below. The females prefer fresh eggs to older ones and have never been induced to oviposit in eggs more than 5 or 6 hours old. The average rate of oviposition in fresh eggs has been observed to be one every 25 seconds, but it takes longer to oviposit in older eggs. From 1 to 8



females have been observed ovipositing on the same egg mass at the same time. They appear to be able to determine to some extent which eggs have been parasitized, since females have been observed to fly away without attempting to oviposit after examining an egg mass upon which several females had previously oviposited. No egg mass has ever been found to be completely parasitized, since some tabanid larvae have hatched from each of the several hundred masses collected. In collected egg masses, 93 per cent is the highest percentage of parasitization of any single mass; the average in any considerable number of masses has never been above 60 per cent, as determined by the number of adult parasites emerging and the number of tabanid larvae hatching. (Fig. 2.)

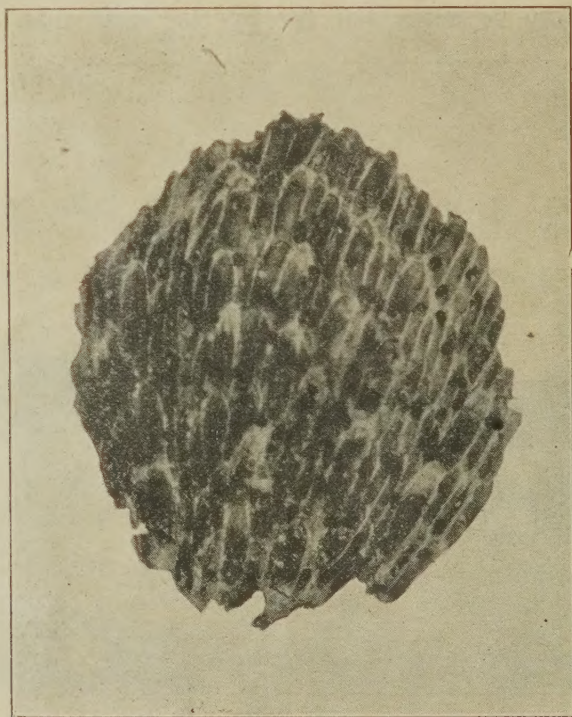


FIG. 2.—Mass of eggs of *Tabanus hyalinipennis* (viewed from above), showing emergence holes of the parasite. These egg masses are usually about one-half of an inch across

There are not enough data at hand to determine the number of young a single female *Phanurus* is capable of producing. From three masses of fly eggs which had been attacked by a collected female parasite, 114 adult parasites have been reared.

The males usually die within a few hours after copulation and the females die soon after oviposition has been completed. Adults have rarely ever lived longer than two days in the breeding jars and none for more than five days. The adults have been supplied with water, sweets, and flowers in the breeding jars, but have never been observed to feed. They have bred quite freely in 4-ounce tumblers, pint Mason jars, and smaller shell vials. It has been found advantageous to introduce moisture into the jars by placing clean moist



sand in the bottom. Females have been transferred from one egg mass to another without appreciably interfering with the process of oviposition.

At Uvalde the total developmental period for the immature stages has ranged from 12 to 19 days, the average being 17.3 days, from oviposition to emergence of the adults. The incubation period of *Tabanus hyalinipennis* eggs has been from 5 to 9 days, usually 7 to 8 days. The immature stages appear to require a certain amount of moisture, since many did not develop in egg masses collected and kept in pill boxes without any moisture during hot dry weather.

Adult parasites begin to appear in the early summer as soon as the weather has continued hot for some days. The earliest recorded appearance was from eggs collected April 23, 1920, from which adults emerged on May 10. The latest emergence was October 1, 1914.

### TABANID EGG COLLECTING AND PARASITE DISSEMINATION

After the tabanid eggs had been located in great numbers and the egg parasite discovered in the late summer of 1914, some ranchmen about Laguna Crossing, following the suggestion of the writer, collected the eggs along the stream for a distance of 14 miles and placed them in tin cans and buckets along the river. It was not possible to determine accurately the quantity of eggs collected by the ranchmen, but it was estimated at approximately 10 to 12 gallons of masses, or 20,000,000 to 25,000,000 eggs. This section was the most heavily infested with horseflies of any during 1914.

During the early part of the season of 1915 it was estimated that there had been a 50 per cent greater decrease in the number of flies in the area where the eggs had been collected than in other similar areas not so treated. Eggs collected at the time of the examinations along this part of the river were more heavily parasitized than at other places, samples averaging 50 per cent or above.

During July, August, and September, 1915, parasitized eggs were collected along about 40 miles of the Nueces River and distributed in streams over the other parts of the escarpment. One hundred and five distributions of from one-fourth to 1 pint at each place were made, and a total of 52 pints of eggs were used. At the time the distributions were made, samples of egg masses were collected from each place to determine whether the parasite was already present. Parasites were reared from 51 of the 105 collections. They were found over the entire escarpment but were found more generally distributed in the western half. From 1916 to 1926, inclusive, egg masses were collected each year over portions of the area to determine if the parasite was still present. A total of 139 collections have been made and parasites have been reared from 136. They have remained rather well distributed, but the percentage of eggs parasitized has usually been less in the eastern half than in the western half of the area. This indicates that the parasite would be more effective in tabanid control in areas of light rainfall.



## SOME FACTORS THAT HAVE PROBABLY CONTRIBUTED IN CONTROLLING THE HORSEFLIES

There has been a general decrease in the number of horseflies on the escarpment since 1914. Several factors have entered that might have augmented this decrease; however, it is believed that the general distribution of the parasite, supplemented by egg collections, has been one of the potent factors. Of the several thousand specimens reared from collected egg masses, *Phanurus emersoni* has been the only egg parasite recognized. Several predators of the fly eggs, larvae, pupae, and adults have been observed, but none of these has been recognized as having any considerable value in keeping the tabanids in check.

Undoubtedly climatological factors have had a considerable effect on the breeding of the flies and their enemies. A very severe drought during the years of 1917 and 1918 decreased the fly-breeding area by drying up the streams except in the heads of the valleys. This condition has interfered with obtaining more accurate data as to the benefits that might be expected from the work of the parasite. There was a general outbreak of tabanids during the summer of 1920, about 75 per cent as many as in 1914. The summers of 1913 and 1919 were characterized by heavy summer rainfall. The streams in the area have flowed as freely during most years as during 1913 and 1919, but when the summers have been characterized by light rainfall and a high percentage of sunshine the tabanids have decreased. It is estimated that the parasite has destroyed 50 per cent or more of the tabanid eggs during the most favorable seasons for its work, and 10 per cent or less in the most unfavorable seasons.

## CONCLUSIONS

*Phanurus emersoni* has been a potent factor in the control of tabanids along the south escarpment of the Edwards Plateau, north of Uvalde, Tex.

The parasite does its most effective work during seasons with a high percentage of sunshine.

The artificial dissemination of the parasite has apparently established it more generally over the escarpment on which its host breeds.

Egg-parasite rearing and dissemination, augmented by tabanid egg collecting (under conditions to be determined by the percentage of tabanid eggs parasitized, the number of tabanid eggs present, and the accessibility of the eggs for collecting), is a feasible method of tabanid control under certain climatic and physical conditions.

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December 22, 1927

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